



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

No. of license.	Establishments.	Products.
19	Memorial Institute for Infectious Diseases, Chicago, Ill.	Diphtheria antitoxin.
21	Swiss Serum and Vaccine Institute, Berne, Switzerland.	Diphtheria antitoxin, antidysenteric serum, antimeningococcal serum, antipneumonic serum, antiplague serum, antistreptococcal serum, tuberculin, anticholera vaccine, antiplague vaccine, antityphoid vaccine, and antitetanic serum.
22	Institut Bactériologique de Lyon, Lyon, France.	Antidiphtheric serum and normal goat serum.
23	Bacterio-Therapeutic Laboratory, Asheville, N. C.	Tuberculin.
24	Farbwerke, vormals Meister Lucius und Brüning, Hoechst-on-Main, Germany.	Diphtheria antitoxin, antidysenteric serum, antimeningococcal serum, antipneumonic serum, antistreptococcal serum, antitetanic serum, and tuberculin.
25	Tuberculin Society of St. Petersburg, St. Petersburg, Russia.	Tuberculinum purum.
27	Institut Pasteur de Lille, Lille, France.	Sérum antivenimeux.
29	The Behringwerk, Marburg, Germany.	Antitetanic serum and tuberculin.
30	Dr. G. H. Sherman, Detroit, Mich.....	Bacterial vaccines.
31	E. Merck, Darmstadt, Germany.....	Antidiphtheric serum, antimeningococcal serum, antipneumonic serum, antistreptococcal serum, normal horse serum (liquid and dried), equine serum, tuberculin, bacterial vaccines, and leucofermantin (antitryptic sheep serum).
32	Kalle & Co., Biebrich, Germany.....	Tuberculin (Rosenbach).
33	American Biologic Co., Kansas City, Mo.	Antirabic virus.
34	The Bérameck Laboratory, Neuchâtel, Switzerland.	Tuberculin (Bérameck).
35	Dr. Carl Spengler, Davos-Platz, Switzerland.	I. K. immune blood.
36	Dr. C. L. McDonald, Cleveland, Ohio.	Bacterial vaccines.
37	Western Biological Co., Kansas City, Kans.	Do.
38	Laboratorio di Terapia Sperimentale (Bruschettini), Genoa, Italy.	Tuberculosis serum-vaccine.
39	Pharmaceutisches Institut Ludwig Wilhelm Gans, Oberursel, near Frankfort on the Main, Germany.	Antidysenteric serum.

NOTES ON THE BIONOMICS OF RATS AND GROUND SQUIRRELS.

By GEORGE W. MCCOY,

Passed Assistant Surgeon, Public Health and Marine-Hospital Service.

During the past three years several interesting facts in connection with the life histories of rats and of ground squirrels have been noted at the Federal Laboratory, San Francisco, Cal. While it is quite probable that none of these are new, yet it seemed proper to make them a matter of record, not only on account of the importance of these rodents for public health reasons, but also from an economic point of view.

BREEDING AND RAISING IN CAPTIVITY.

On a few occasions rats and squirrels were born to mothers that had been trapped, but several attempts at mating and breeding in captivity were unsuccessful. We have succeeded in raising one litter, born a short time after the mother was caught. The facts are as follows: Nine rats (*Mus norvegicus*) were born on May 29, 1909. As we had found that the wild mother in captivity usually killed her offspring, they were given to a white rat that had recently given birth to young. The gray and the white litters lived together in perfect harmony, and the white mother nourished impartially the two families. When the wild rats were about three weeks old, they were placed

in a box cage and fed on bread and milk. They thrived and grew, but gave no evidence of having been domesticated by being raised in relatively decent surroundings. They attempted to escape and some succeeded. They were as ready to bite man as wild rats usually are.

The most interesting feature in connection with the raising of these rodents was the rate of growth. They were first weighed on August 1, 1909, when they were 62 days old. Five of them gave the following weights in grams: 85, 80, 85, 90, 75, an average of 81 grams. A month later—that is, when they were 3 months old—seven were weighed, giving the following figures in grams: 135, 120, 120, 90, 105, 105, 85, an average of 108 grams. On November 1—that is, when 5 months old—one remained, the others having escaped or been killed. The survivor weighed 142 grams. Judged by the majority that came under observation, a rat weighing 142 grams is about three-fourths grown. Before leaving this subject I should say that at the time the unsuccessful attempts at breeding wild rats were made we were having no difficulty in raising white ones.

We have only indirect evidence about the rate of growth of squirrels, but it is believed to be reliable. The great majority of young squirrels are born during the months of March, April, and May. During these and two or three subsequent months many young are sent to the laboratory, but by September practically none come in except such as we classify as three-fourths grown or grown. I should say that squirrels reach the size of the average adult in from four to six months.

LIFE IN CAPTIVITY.

It is sometimes stated that wild rats in captivity do not live long. This has not been our experience. We have kept these rodents in cages for more than a year. There is a heavy mortality during the first few days after a number of rats are put together in a cage. We believe this is due to fighting. After what may be called an equilibrium has been established there is no further loss. With ground squirrels there is practically no mortality even in the beginning of captivity. We have kept them in cages for nearly a year, during which period they remained well and grew fat.

BREEDING SEASONS.

We have kept daily records of the number of pregnant rodents and the number of fetuses in each. The results are shown in the following tables arranged by weeks:

RATS.

Week ended—	Females per 100 males.	Pregnant per 100 females.	Average number of fetuses.	Week ended—	Females per 100 males.	Pregnant per 100 females.	Average number of fetuses.
1908.							
Dec. 5.....	196	2.7	8.5	Jan. 2.....	224	5.6	8.9
Dec. 12.....	210	3.8	8.0	Jan. 9.....	191	5.4	8.5
Dec. 19.....	200	4.3	8.0	Jan. 16.....	206	5.2	9.0
Dec. 26.....	243	4.3	8.6	Jan. 23.....	204	5.0	8.3

July 5, 1912

1070

RATS—Continued.

Week ended—	Females per 100 males.	Pregnant per 100 females.	Average number of fetuses.	Week ended—	Females per 100 males.	Pregnant per 100 females.	Average number of fetuses.
1909.							
Jan. 30	188	4.1	8.0	Jan. 1	194	3.7	8.2
Feb. 6	168	4.0	9.0	Jan. 8	181	5.8	7.9
Feb. 13	189	5.0	8.8	Jan. 15	183	4.7	7.2
Feb. 20	167	5.0	7.4	Jan. 22	165	5.1	7.4
Feb. 27	198	6.6	8.0	Jan. 29	168	5.6	7.9
Mar. 6	180	3.1	8.5	Feb. 5	162	5.1	7.6
Mar. 13	191	5.1	8.8	Feb. 12	167	5.5	7.4
Mar. 20	174	4.7	8.1	Feb. 19	183	5.0	7.4
Mar. 27	178	6.4	9.0	Feb. 26	183	8.0	3.2
Apr. 3	170	4.8	9.1	Mar. 5	191	10.0	7.6
Apr. 10	228	4.7	8.0	Mar. 12	163	7.7	7.7
Apr. 17	226	5.1	8.6	Mar. 19	159	9.5	8.0
Apr. 24	224	4.2	7.4	Mar. 26	158	5.7	8.0
May 1	238	5.4	7.3	Apr. 2	167	6.6	8.1
May 8	240	4.9	7.7	Apr. 9	160	7.4	8.0
May 15	245	7.1	8.0	Apr. 16	169	5.5	8.0
May 22	201	6.0	8.3	Apr. 23	175	5.1	7.7
May 29	211	4.6	8.1	Apr. 30	187	5.3	6.8
June 5	230	7.1	8.5	May 7	165	6.9	7.7
June 12	226	6.5	8.4	May 14	172	6.6	8.8
June 19	206	8.6	8.0	May 21	166	6.4	7.9
June 26	198	5.4	8.0	May 28	235	6.3	7.9
July 3	207	5.6	7.8	June 4	152	7.5	7.9
July 10	204	5.0	8.0	June 11	163	6.2	8.5
July 17	204	6.0	7.6	June 18	193	4.2	7.6
July 24	202	8.0	7.5	June 25	164	4.9	7.8
July 31	199	4.7	7.4	July 2	162	7.6	7.2
Aug. 7	188	3.8	8.0	July 9	153	5.4	8.1
Aug. 14	202	4.5	7.6	July 16	156	6.4	8.0
Aug. 21	182	5.0	7.5	July 23	158	6.7	8.1
Aug. 28	129	4.2	8.2	July 30	140	6.8	7.5
Sept. 4	185	5.6	8.9	Aug. 6	156	7.8	8.0
Sept. 11	202	3.1	8.2	Aug. 13	188	6.9	7.6
Sept. 18	176	4.6	8.3	Aug. 20	143	4.8	7.8
Sept. 25	157	8.8	7.4	Aug. 27	163	5.4	8.2
Oct. 2	164	3.0	7.4	Sept. 3	167	7.8	8.2
Oct. 9	305	4.0	8.3	Sept. 10	135	6.2	7.8
Oct. 16	195	3.8	8.3	Sept. 17	130	8.1	8.8
Oct. 23	274	6.3	7.1	Sept. 24	150	7.5	8.2
Oct. 30	204	5.1	7.2	Oct. 1	151	8.6	7.3
Nov. 6	223	6.7	7.4	Oct. 8	156	9.3	4.8
Nov. 13	199	5.1	7.7	Oct. 15	124	7.5	8.7
Nov. 20	301	3.6	7.0	Oct. 22	120	8.1	7.8
Nov. 27	185	3.9	8.0	Oct. 29	103	6.8	7.4
Dec. 4	156	4.7	8.3	Nov. 5	119	8.3	8.4
Dec. 11	144	6.7	8.0				
Dec. 18	167	5.2	7.7				
Dec. 25	182	6.3	8.0				

SQUIRRELS.

1909.				1910.			
July 3	178			Jan. 1	75	0.47	9.0
July 10	168			Jan. 8	90		
July 17	195			Jan. 15	80	.7	5.5
July 24	171			Jan. 22	73	.7	8.1
July 31	144			Jan. 29	122	.2	7.5
Aug. 7	143			Feb. 5	83	.5	6.4
Aug. 14	199			Feb. 12	80	11.0	6.7
Aug. 21	134			Feb. 19	88	19.0	7.2
Aug. 28	126			Feb. 26	90	42.0	7.4
Sept. 4	109			Mar. 5	115	27.0	6.4
Sept. 11	171			Mar. 12	110	24.0	7.4
Sept. 18	129			Mar. 19	128	21.0	7.5
Sept. 25	125			Mar. 26	153	19.0	8.0
Oct. 2	227			Apr. 2	144	20.0	8.0
Oct. 9	150			Apr. 9	168	16.0	7.2
Oct. 16	84			Apr. 16	190	3.7	7.9
Oct. 23	112			Apr. 23	184	3.5	7.3
Oct. 30	159			Apr. 30	171	3.7	7.3
Nov. 6	107			May 7	190	5.0	7.1
Nov. 13	142			May 14	180	1.3	5.9
Nov. 20	73			May 21	200	1.1	7.5
Nov. 27	92			May 28	181		
Dec. 4	113			June 4	166	.2	6.0
Dec. 11	75			June 11	161		
Dec. 18	94			June 18	137		
Dec. 25	93			June 25	146		

SQUIRRELS—Continued.

Week ended—	Females per 100 males.	Pregnant per 100 females.	Average number of fetuses.	Week ended—	Females per 100 males.	Pregnant per 100 females.	Average number of fetuses.
1910,							
July 2.....	159	.....	.....	Sept. 10.....	139	.....	.....
July 9.....	118	.....	.....	Sept. 17.....	138	.....	.....
July 16.....	170	.....	.....	Sept. 24.....	121	.....	.....
July 23.....	139	.....	.....	Oct. 1.....	130	.....	.....
July 30.....	140	.....	.....	Oct. 8.....	134	.....	.....
Aug. 6.....	161	.....	.....	Oct. 15.....	130	.....	.....
Aug. 13.....	158	.....	.....	Oct. 22.....	100.5	.....	.....
Aug. 20.....	151	.....	.....	Oct. 29.....	108	.....	.....
Aug. 27.....	140	.....	.....	Nov. 5.....	113	.....	.....
Sept. 3.....	139	.....	.....		

It will be seen at a glance that in San Francisco there is no definite breeding season for rats (*Mus norvegicus*). This is in accord with the observations of the Indian Plague Commission (Journal of Hygiene, Vol. VII., 1907, p. 749) in Bombay, India. With ground squirrels in California the case is quite different, as pregnant rodents are found almost exclusively in February, March, and April, with very few in January and in May.

It should be stated here that the figures on which the proportions and percentages in the preceding tables are calculated were never less than 1,000 rats and the same number of squirrels per week.

One other point of interest may be mentioned in this connection. In ground squirrels during the rutting season the testicles grow very large, at times as large as the last joint of one's thumb, while during the remainder of the year they exist as tough shriveled fibrous masses, usually a little larger than a pea and often hard to find. No such seasonal change is noted in the sexual glands of rats.

FOODS.

We have no observations to offer on the food of rats under natural conditions. In captivity they get along well on cheese, bacon, and bread.

The food of ground squirrels is easily studied as they store it in their cheek pouches for a time. Examination shows chiefly seeds and grain of various sorts. During the spring months they eat enormous quantities of green grass. In captivity we feed them grain, and occasionally cabbage and carrots.

STARVATION OF RATS.

On account of the importance of the possible transportation of a live plague-infected rat from one place to another, it seemed important to determine how long rats would live on certain restricted diets and in the absence of drinking water. The results are shown here. The rats were all *Mus norvegicus*.

Without food and water.

(Absolute starvation.)

1 small rat lived 3 days.

1 grown rat lived 3 days.

1 large rat lived 5 days.

Each of 3 large rats lived 2 days.

Without food but with water.

1 large rat lived 3 days.

Fed on carrots and cabbage only.

1 large rat lived 4 days.

Fed on dry grain (wheat) only, no water.

1 half-grown rat lived 10 days.

1 half-grown rat lived 12 days.

1 half-grown rat lived 15 days.

1 large rat lived 4 days.

1 large rat lived 6 days.

1 large rat was alive 35 days after the experiment was begun.

Fed on bread, meat, and cheese only, no water.

Three half-grown rats were put on this diet. All were alive and well 60 days after the experiment was begun. On the 15th day one was given an opportunity to drink water, but it made no effort to partake of any.

Fourteen rats, all under 175 grams in weight, were kept for 30 days on a diet of bread, meat, cheese, carrots. At the end of that period they were all apparently in perfect health.